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APPLICATION FOR U.S. LETTERS PATENT

Title:

SINGLE SIDED ADHESIVE TAPE FOR COMPOUND DIVERSION ON BOC SUBSTRATES

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BACKGROUND OF THE INVENTION

I. FIELD OF THE INVENTION

The present invention relates generally to semiconductor die packaging. More particularly, the present invention relates to an adhesive system and method for encapsulation of a die attached to a circuit board.

II. DESCRIPTION OF THE RELATED ART

A board-on-chip (BOC) is a semiconductor integrated circuit (IC) device where the die and the circuit board are attached and encapsulated as one package. The die and board are typically attached, prior to encapsulation, by double sided adhesive tape applied to the bottom of the board and top of the die. The die is also electrically connected to the board by wirebonds. The then attached die and board are completely encapsulated (packaged) for protection with a compound, such as plastic. The compound is injected into a mold and onto the die and board at a high pressure in a hot molten liquid form. The compound then cools and hardens to form a protective package. The encapsulation process is complex because a desired exterior surface of the board, containing the ball grid arrays (BGA), must only be partially sealed with the compound used for encapsulation. In particular, the wirebonds on the exterior surface of the board must be sealed with the encapsulating compound but the compound cannot contact the ball grid arrays. If the compound contacts the balls of a ball grid array the device

will be damaged because the connectivity of the board to external circuits will be negatively effected.

FIGS. 1(a)-1(c) illustrate a conventional BOC package 100 with FIG. 1(a) showing a side view. In a conventional BOC package 100, the board 102 is physically attached to the die 104 by two pieces of double sided adhesive tape 106, 108 placed in between the die 104 and board 102. The die 104 is electrically connected to the board 102 by wirebonds 110 which pass through a wirebond slot 112 in board 102. The wirebonds 110 are all physically located between the two pieces of adhesive tape 106, 108 in the wirebond slot 112.

During encapsulation the compound must fill the wirebond slot 112 and cover all wirebonds 110 on the board 102, but the compound must not flow beyond the edges of the ball grid arrays 114, 116. FIG. 1(b) illustrates a top view of the conventional BOC package 100 and provides a clear depiction of the ball grid arrays 118, 122, the edges of the ball grid arrays 114, 116, and the wirebond slot 112.

FIG. 1(c) illustrates a cross sectional view of the BOC package along line A-A of FIG 1(a) (the area between the die 104 and board 102). Referring to FIG. 1(c), during encapsulation the compound is introduce into the BOC package under high pressure at the gate 120. The compound then begins to fill a mold containing the die 104 and encapsulates the BOC package 100 in the direction of arrows 140 –148. In this conventional BOC package 100 the wirebond slot 112 may fill before the compound has completely encapsulated the entire die 104. Thus, the compound may begin

to flow up and over the top of the board 102 and past the edges of the ball grid arrays 114, 116 before the die 104 is encapsulated. As described above, when the compound contacts the ball grid arrays 118, 122 the BOC package will be damaged.

The foregoing problems of encapsulation of a BOC package are undesirable aspects of conventional semiconductor packaging techniques. A system and method are needed to better encapsulate a BOC package such that the ball grid array will not be damaged during encapsulation.

SUMMARY OF THE INVENTION

The present invention provides an efficient adhesive tape system and method for a BOC package which allows for better encapsulation. The present invention adds a small piece of material, for example, adhesive tape, oriented perpendicular to the conventional two-piece tape system used to attached a die to a circuit board. The material is located in front of the gate of the BOC package during encapsulation to form a diversion dam thereby causing a compound during encapsulation to fill the wirebond slot last. By filling the wirebond slot last, the present invention prevents overflow of the compound, thus ensuring that the ball grid arrays will not be damaged.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other advantages and features of the invention will become more apparent from the detailed description of exemplary embodiments provided below with reference to the accompanying drawings in which:

FIG. 1(a) is a side view of a conventional BOC package;

FIG. 1(b) is a top view of a conventional BOC package;

FIG. 1(c) is a cross sectional view of the area between the die and circuit board of a conventional BOC package;

FIG. 2 is a cross sectional view of the area between the die and circuit board of the present invention; and

FIG. 3 illustrates a processor system including a semiconductor package employing the adhesive tape system and method of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings, where like reference numerals designate like elements, there is shown in FIG. 2 an improved BOC package 200 which during encapsulation allows for encapsulation without overflow onto the ball grid array. Improved BOC package 200 includes the conventional two-piece double-sided adhesive 106, 108 used to attach the die 104 to the board 102 prior to encapsulation. To aid in encapsulation, the improved BOC package adds a smaller third piece of material, for example, adhesive tape 202 perpendicular to the two pieces of double sided adhesive 106, 108 to block the wirebond slot 112 on the side of the wirebond slot 112 closest to the gate 120. The material 202 thereby forms a diversion dam to divert the compound from filling the wirebond slot 112 before encapsulating the die 104 during encapsulation. The material 202 if formed

as a third piece of tape need only have adhesive on one side because the material 202 is not needed to aid in attaching the pre-encapsulated die 104 to the board 102 since the two piece double sided adhesive 106, 108 are adequate for attachment.

During encapsulation, the material 202 diverts the infused compound from the wirebond slot 112 such that the compound first fills the area surrounding the bottom of the die 104 (opposite the side of gate 120), then fills the area surrounding the perimeter of the die 104 and thereafter the wirebond slot 112 is filled with the compound as illustrated by directional arrows 204-216. Thus, since the wirebond slot 112 is the last portion of the improved BOC package 200 to become encapsulated, no overflow exists to damage the ball grid arrays.

FIG. 3 illustrates a simplified processor system 300 which may employ die and circuit boards employing the BOC package of the present invention as described and illustrated with reference to FIG. 2. Processor system 300 includes central processing unit (CPU) 302, RAM and ROM memories 312, 314, input/output (I/O) devices 308, 310, disk drive 304 and CD ROM drive 306 All of the above components communicate with each other over bus structure 316, which may include one or more buses. The CPU 302 or memories 312, 314 may use the improved BOC package of the present invention as described and illustrated with reference to FIG. 2 to encapsulate the BOC package without damaging the ball grid arrays. RAM memory devices 312 and CPU 302 may also be integrated together on a single chip. In addition, one or more dedicated RAM memory devices may be

encapsulate to form the improved BOC package and then a plurality of such packaged devices may be arranged in a memory module.

While an exemplary embodiment of invention has been described and illustrated, it is to be understood that the above description is intended to be illustrative and not restrictive. Many variations to the above-described system and method will be readily apparent to those having ordinary skill in the art. For example, a single-sided or double-sided piece of adhesive tape may be used as the diversion material. Further, instead a using adhesive tape for the diversion dam a thin layer of other material can be deposited between the die and circuit board, where the thin layer of material has sufficient heating characteristics to maintain its form during encapsulation.

Also, although the invention has been described with reference to use of double sided tape to secure a die to a circuit board, the invention can be implemented with two stripes of any type of adhesive material which can suitable fasten the die and circuit board together.

Accordingly, the present invention is not to be considered as limited by the specifics of the particular system and method which have been described and illustrated, but is only limited by the scope of the appended claims.

What is claimed as new and desired to be protected by Letters Patent of the United States is: